United States Department of Agriculture
Forest Service
NE-INF-42-81

Surface-mine Reclamation at Berea

Surface-mine Reclamation Research at Berea

The Appalachian Mountains are as plentiful in natural resources as they are in history and lore. Millions of acres of trees, abundant wildlife, and miles of rushing water give these hills a rich appeal.

Natural riches of another sort rest beneath the Appalachian soil. Always vital to Appalachian economics, coal has recently become important to the nation as a whole. Since 1964 more coal has been mined in Appalachia each succeeding year, a response to our growing need for energy.

In mining for coal, other natural resources are often disturbed. Trees are uprooted, streams filled with sediment, and wildlife forced from their homes. More than two million acres of Appalachian land had been disturbed by coal surface-mining by the end of 1977. The annual rate of disturbance is expected to increase each year.

Surface mining begins with a series of terrific blasts. Layers of soil and rock laid down through geologic time and known as the overburden are suddenly shattered, exposing the coal beneath. The resulting mix of rock fragments and topsoil is called "spoil."

Spoil immediately starts to break down and weather, bringing chemical and physical changes. The steepness of Appalachian slopes often creates an unstable surface, encouraging erosion and creep. These unsightly deposits mar the landscape. They pollute streams with sediment and acidic or toxic materials. They resist plant life, and often defy hopes for future use of mined land.

How can we reconcile our need for coal with our desire for a quality environment and productive lands?

One answer lies in solving the technical and environmental problems imposed by mining on mountainous terrain. This is a major objective of research at the USDA Forest Service's Northeastern Forest Experiment Station laboratory in Berea, Ky.

The Berea laboratory houses the most comprehensive surface-mine reclamation research operation in the country. Of the 300,000 acres disturbed during surface mining in 1980, 90 percent occurred in the East, mainly within the area covered by reseach at Berea.

More than 50 studies are conducted at Berea. Scientists there develop methods and standards for mining that will prevent erosion and other watershed damage. They look for ways to encourage rapid and lasting revegation. They also explore methods for controlling the quantity and quality of streamflow. Though located in Kentucky, they collect and analyze information from West Virginia, Tennessee, Alabama, Ohio, Maryland, Virginia, and Pennsylvania as well.

Berea researchers work on problems in five major areas. Each overlaps with the others in some way, and together they form a comprehensive, integrated program of reclamation research.

The basic building block for reclamation is the overburden. Overburden itself consists of many different strata or layers. Geologists have learned to characterize these strata according to their mineral content, and chemical and physical properties.

Exposed to the weather, some strata turn acidic and toxic. They release substances that discourage plant life and degrade streamwater quality. Other strata release benefical substances, and can serve as a good growth medium. Physically, some strata become heavy clay or loose sand, while others take on a good soil texture.

With this knowledge before them, researchers hope to be able to prescribe ways to remove and place strata to form a material with the best possible qualities. In some cases, this may mean complete isolation of a particular strata from the environment. Or it may mean blending two or more strata to achieve desirable properties. Researchers hope that future reclamation plans will consider the important role of overburden strata. Careful placement of strata could do much to reduce stream pollution, encourage plant growth, and cut back on the need for water treatment and expensive soil amendments.

The effects of strata placement are closely watched by hydrology researchers at Berea. They are concerned about excess acid and sediment entering streams from mined areas. They conduct research to characterize pollutants according to quantity, content, and source.

In future studies, they want to evaluate the rate at which mine spoils weather. This will tell them how quickly acid is produced, and then neutralized on its way to the stream.

Hydrologists also watch the quantity of water leaving a mined area. They have found that instead of increasing the likelihood of floods, surface-mining tends to reduce flood peaks and to increase flow during low periods. They will continue to collect data on water quality and streamflow, to help determine the consequences of future mining and reclamation. The information they gather could be used to design systems that will minimize adverse effects.

Once the problems with overburden and water are under control, revegetation can take place. This is the essential step to final control of run-off and erosion, to a return to beauty and productivity.

In 15-20 years of research, scientists have identified the best species and techniques to use in establishing herbaceous cover on most surface-mined land. Their research also showed that many species of trees will grow on the more gently sloping mine spoils.

Herbaceous cover is essential for successful reclamation in most areas. In many, trees and shrubs are also needed for wildlife habitat and other uses. Unfortunately for trees, these two forms of vegetation often compete. In

addition, soil at reclamation sites is often compacted from moving, grading, and replacement practices, which hinders establishment of trees.

In future studies, researchers will measure the effects of compacted soil, determine how to alleviate any adverse effects, and identify which species and techniques should be used together for successful revegetation.

Trees may eventually grow better on stripped land with the help of microorganisms. For instance, these tiny life forms have been inoculated into pine seedlings to increase their chances of survival on inhospitable minesoils.

Research into the usefulness of microorganisms has also shown that they may contribute to good soil texture and performance. Mulches such as bark, straw and hay are broken down by microorganisms. Chemicals that increase the water stability of minesoils are then generated.

Scientists at Berea are continuing research into the role of soil microorganisms in encouraging plant growth on strip-mined sites. They need to expand techniques for inoculating seedlings with microorganisms. They also want to examine the effects that certain symbiotic relationships have on microorganisms' role in aiding plant growth.

In addition to how well trees grow, where trees grow is an important consideration. This is the concern of landscape architects, who look at the effects of surface mining on landscape quality.

In the past they have mainly provided support to other studies, conducted field evaluations, developed guidelines for applying the principles of their trade to mining, and contributed to the analysis, planning, and design of revegetation schemes.

A future effort will be to identify and quantify typical landscapes in the Appalachian coal field. Scientists will assess landscapes' capacity to absorb the changes brought on by surface mining. They will look at people's attitude toward and preferences concerning mining and reclamation.

Other research will involve evaluating past and present mining activities to provide a basis for setting new design requirements and performance standards. To aid future reclamation efforts, they will develop computer programs that preview the visual effects of mining, so that steps can be taken to enhance landscape quality.

These are the major areas of current research at Berea. In 20 years of reclamation research, many other problems have been addressed. The results are contained in numerous publications available from the scientists or the Station publications office upon request.

* * *

Research at Berea is accomplished through cooperation with many institutions, organizations, and agencies. The list includes state universities, reclamation associations, and federal agencies, among other groups. A complete list of cooperators can be obtained from project staff members.